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MANGANESE

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OF

SUBCOMMITTEE ON MINERALS, MATERIALS, AND FUELS

TO THE

COMMITTEE ON INTERIOR AND INSULAR AFFAIRS

UNITED STATES SENATE

EIGHTY-FOURTH CONGRESS

First Session

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MANGANESE

A great deal of misinformation has been disseminated about the Government's low-grade manganese purchase programs. The completely erroneous statement has even been made that most of the ore which has been purchased is unusable and, consequently, the Government has literally wasted millions of dollars of the taxpayers' money. It is unusable only if no serious efforts are made to beneficiate it to a usable product.

To determine the precise situation, Senator James E. Murray, chairman of the Minerals, Materials, and Fuels Subcommittee of the Committee on Interior and Insular Affairs, called hearings, which were held on April 12, 13, and 14, 1955, at which time witnesses representing both industry and Government agencies testified in detail. Copies of these hearings are available from the subcommittee.

The subcommittee found:

(1) These purchases of low-grade manganese have been fully justified.

(*a*) The material can be beneficiated.

(*b*) National defense makes it imperative that this Nation have adequate stored reserves of usable manganese to meet our steelmaking needs in time of emergency.

(*c*) Much larger quantities of manganese ores than are now stored in the purchase depots are needed if the Nation is to be spared the grim specter of a breakdown in its steelmaking capacity during an emergency.

(*d*) National defense also makes it imperative that this Nation have a continuously operating manganese industry—from mine production of domestic ore to a product ready for the ultimate user—at all times.

(2) Far too much time has been wasted in experimental dilly-dallying in respect to beneficiation processes, and the time has arrived to do adequate pilot-plant work with a view of building full-scale plants to upgrade the presently stored low-grade ores. Such pilot plants and beneficiating plants should be privately operated with Bureau of Mines supervision specified where Government financial aid is involved. This cannot be emphasized too firmly as has been demonstrated by past experience.

(3) Low-grade ore purchases should be continued and the mines kept open so that they can furnish ore to any and all beneficiation plants built.

(4) Full-scale plants should be established not only at present purchase depots, but also at or near the sites of our major manganese deposits.

The subcommittee was impressed with the testimony regarding the length of time which will be required to get such plants into

operation. It was demonstrated that if preliminary work on beneficiation is stopped at the pilot-plant stage and then an attempt is made to get the major manganese ore properties into production during a war, from 2 to 3 years may be required, with major requirements of manpower, materials, and electricity, the allocation of which might then be impossible to obtain.

It is not only recommended that these plants be built and operated during peacetime, but that end products, as far as is possible, be stockpiled, such end products as electrolytic manganese and ferromanganese in which the ultimate amounts of manpower, electric power, and other materials are locked up.

Electrolytic manganese and ferromanganese should be placed on the list of critical materials to be stockpiled.

One of the foremost metallurgists in the country in the field of manganese metallurgy, Dr. Reginald S. Dean, originator of the Dean-Leute carbonate process and pioneer in the electrolytic process, testified that in his opinion the low-grade manganese ores of this country should go into the making of metallic manganese or other high-grade products, rather than be upgraded just to compete with foreign ores.

It will take an adjustment of thinking as well as process and procedures to change the established order of operations—industry is notoriously conservative in such matters—and the Government should lead the way before a great emergency compels it to the nearly impossible task of realistically expanding domestic production under war conditions.

The subcommittee cannot urge too strongly that, in order to maintain a realistic domestic mobilization base in manganese, continuing purchase programs at adequate prices are warranted and plants to process the ores into usable form should be built as soon as possible. If necessary, legislation to implement this program should be enacted.

The Department of the Interior, through the Bureau of Mines, should, without delay, formulate and recommend to the Congress an integrated program to implement the principles enunciated above, and to give force and effect to the administration's declared policy to eliminate "distress areas" afflicting the national economy and our overall defense potential. Until this is done, the administration's policy declarations in respect to elimination of "distress areas" and "broadening of the mobilization base," as it relates to the mineral industry, will remain nothing more than sounding of brass and tinkling of cymbals.

Deeply concerned by the Department of Interior's failure to initiate a realistic manganese research program, the subcommittee on April 13, 1955, requested the Department to submit such a suggested program. On August 1, 1955, the Department replied as follows:

UNITED STATES DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington 25, D. C., August 1, 1955.

Hon. JAMES E. MURRAY,
United States Senate, Washington 25, D. C.

MY DEAR SENATOR MURRAY: In the course of the hearings of the Subcommittee on Minerals, Materials, and Fuels Economics, on April 13, 1955, you requested the Bureau of Mines witnesses to submit a program on manganese research over an extended period of time which could provide more definite answers as to the feasibility of treating large domestic deposits of manganese-bearing ores during

emergency periods. You mentioned particularly such large deposits as the Cuyuna Range, Minn., Aroostook County, Maine, and Artillery Peak, Ariz., as well as the recovery of manganese from open-hearth slags.

Accordingly, we are submitting a tentative possible program covering these areas, but without departmental endorsement. A 7-year program is visualized which includes 2 years of preparation and construction and 5 years of operation of pilot plants which would permit a thorough study of the economics of the various processes as well as the determination of technologic data. The program outlined here is, of course, in addition to the Bureau's regularly planned research work on investigation and development of new processes for production and utilization of manganese and investigation of manganese deposits.

Cuyuna Range, Minn.—This project contemplates the construction and operation of a pilot plant to treat 100 tons daily of manganese-bearing ores averaging 5 percent in manganese. The process used will be the sulfatizing roast followed by water leaching of the sulfatized material. Estimated cost of this project follows:

Engineering and construction	$1, 500, 000
5 years of operation, at $500,000 per year	2, 500, 000
Total	4, 000, 000

Aroostook County, Maine.—This project includes field examinations and exploration to develop those ores in Aroostook County, Maine, which are more amenable to upgrading by leaching methods, and the construction of a pilot plant to permit comparative runs on chloridization, sulfuric acid leaching, sulfatizing, and ammonium carbonate leaching. The costs are estimated as follows:

Field examinations and development of reserves	$650, 000
Completion of laboratory research	700, 000
Engineering and construction of a 100-ton per day pilot plant	2, 000, 000
Operation of pilot plant, 5 years	4, 000, 000
Total	7, 350, 000

Artillery Peak, Ariz.—The pilot plant at Boulder City would be used for this project. Ores from Pioche, Nev., as well as those from Artillery Peak, will be used in this work. Included in the estimated cost are funds for modifying the pilot plant and for necessary development of reserves. Costs are estimated as follows:

Development of ore reserves and modification of Boulder City pilot plant	$500, 000
Operation of pilot plant, 5 years	2, 000, 000
Total	2, 500, 000

Recovery of manganese from open-hearth slags.—The Bureau's blast furnace and other facilities now at Pittsburgh, Pa., but soon to be moved to Bruceton, Pa., with minor modifications, will be suitable for this research. However, to refine the process and establish the economics, it is recommended that the pilot plant be operated for a period of 5 years on a continuous basis The process has already been established as technically feasible, but many refinements and improvements will be necessary before the process is accepted by private industry. Estimated cost of completing this work follows:

Modification of Bureau's facilities	$250, 000
Operation and maintenance of facilities, 5 years at $500,000 per year	2, 500, 000
Total	2, 750, 000

This program should be adequate to permit the design of commercial-size operations and production of high-grade manganese materials from domestic sources. Some of these may prove to be competitive; others will require some form of assistance.

If the Department can furnish further information regarding this program, please advise.

Sincerely yours,

CLARENCE A. DAVIS,
Under Secretary of the Interior.

Following is a history of our domestic manganese program, an analysis of foreign sources, and a short discussion of the principal beneficiation processes now under consideration. More detailed information will be found in the printed hearings.

THE DOMESTIC MANGANESE PROGRAM

The manganese purchase program originally started during World War II, ended in 1945 and was reinstituted under the Defense Production Act of 1950. It was designed to stimulate the production of domestic manganese, to provide an incentive for the discovery and development of mines, and to encourage research work on large low-grade deposits as well as on the ore accumulations at the various purchasing depots. To this end, a price of $2.30 per long dry ton unit was established and under Public Law 206 purchases will continue until the end of June 1958, or until quotas established by the Office of Defense Mobilization are satisfied, whichever comes sooner. One purchase depot already has been closed, having reached its assigned quota.

The Bureau of Mines has received millions of dollars in appropriations over a period of years for the study of our domestic manganese deposits and methods for beneficiation of them. Between 1947 and 1955 it spent on such projects $6,960,960 and for the fiscal year 1956 the sum of $786,565 was appropriated for this work.

Year after year research in the laboratory continues until it almost begins to appear that it is research for the sake of research alone. The Bureau of Mines has failed throughout the years to come up with any constructive, overall plan or program in respect to manganese.

PURCHASE OF DOMESTIC ORES

There was left on hand from purchases made during World War II, 152,000 tons of ore averaging 30.4 percent manganese and containing 3,900,000 units of recoverable manganese, scattered over the country in 6 stockpiles. To this there was added up to July 1, 1955, some 11 million units at 3 purchase depots: Butte-Phillipsburg, 1,728,001 recoverable units; Wenden, 6,108,000 recoverable units; and Deming, 3,256,174 recoverable units of manganese. All the foregoing ores are low grade and are of no immediate use unless beneficiated. Many millions of dollars have been invested in the purchase of these ores which represent many different types. Variations in types of ore, however, is a problem with which we can deal effectively.

Pilot plants are necessary to prove what can be done and to establish cost factors; not test tubes in the laboratory; and, furthermore, as has been pointed out previously, in a wartime emergency, labor, equipment, and power are not available. For this and other reasons, full-scale plants should be built during peacetime. Though a large number of different processes have been investigated by the Bureau of Mines, that agency seems to be unable to make up its mind as to which, if any, processes to try in pilot plants. Research in the laboratory can go on for years, as it already has, without tied-down results unless some actual pilot-plant work is done in the field, preparatory to building full-scale beneficiation plants.

After having gone through 3 wars in the last 40 years, and each time being unprepared to meet the emergency, in the interest of

national security, it is high time that definite steps be taken to firmly establish our Nation in a less vulnerable position as regards this critical mineral. Stockpiling alone is not enough. There are many hundreds of millions of tons of low-grade manganese deposits in the country, the largest of which are in South Dakota, Minnesota, Maine and Arizona.

Only one research project of large pilot-plant size, which has proved commercial possibilities, has survived the enthusiasm of the Korean war. It is in Minnesota on the Cuyuna Range and is under the direction of a private company. Due to unfortunate lack of Government interest, this project may be shut down before this report is in print. The Bureau of Mines has recommended the establishment of a research laboratory and a 100-ton pilot plant in the area, but the more important matter of keeping the present plant operating should have first priority.

The low-grade manganese problem can, perhaps, best be compared to the taconite problem. The taconite problem was finally solved, resulting in making billions of tons of low-grade iron ores available on a competitive basis with high-grade natural ores. To mine and beneficiate our domestic manganese ores to a suitable commercial grade, Government witnesses have stated that it may require a price at least 4 times the world price, which was then around 80 cents per unit. The only way to prove what eventually can be done will have to be through pilot-plant operations, followed by full-scale operations which, it is hoped, may demonstrate costs competitive with imported ores.

It is to the credit of the Bureau of Mines that it initiated the commercial production of electrolytic manganese through research work which was started about 1936. Metallic manganese has proved to be of very great value as an alloying additive for many purposes, and it was testified by an executive of a large steel corporation that for certain purposes, even at present prices, domestically produced electrolytic manganese is in a good competitive position and can be used by the steel industry in large quantities.

The time has come when the Congress should examine the overall mineral situation. We need a United States Department of Mineral Resources. Our great mineral industries lack the recognition that comes with Cabinet representation. The President's Mineral Policy Committee is not a sufficiently coordinated or bold executive policy group for dealing with domestic resources. The Department of the Interior now is the executive agency of the Government that deals with minerals, through the Bureau of Mines and the United States Geological Survey, but it has too many other functions to be able to deal adequately with domestic mineral problems.

One of the functions of the Bureau of Mines is to carry on research on the separation and recovery of domestic minerals, one of the most important of which is manganese. No steel can be made without it. There are no known large, high-grade reserves of manganese in the United States or in North America and only limited supplies in South America, although manganese is one of the most widely distributed domestic ores. Approximately 2 million tons of manganese must be imported annually and the transportation of so vast a quantity has always been a serious problem in times of war emergency. An evaluation of our foreign sources of supply is in order.

FOREIGN MANGANESE SITUATION

During World War II both rail and port facilities were inadequate in India and South Africa to deliver large shipments and, furthermore, the loss of ships carrying manganese and chromite ran as high as 85 percent over a period of many months. No calcaulation is available, and probably none will ever be made, of the final cost per ton of ore actually delivered to our ports. But, when all the costs are added—of loss of men, ships, cargoes, and of maintaining the aircraft, surface and underwater warships necessary to convoy and protect the shipments—the total cost must certainly have reached many thousands of dollars per ton of ore delivered. For an infinitesimally smaller outlay of money, a substantial domestic manganese industry can be developed.

During the Korean war several hundred thousand tons of manganese and chromite, badly needed for American military production, piled up at rail sidings in South Africa and remained there even though the United States supplied locomotives and other equipment on the promise that it would be used to move the ore. Instead, this equipment was diverted to other uses. Transportation difficulties in both India and South Africa, from which come a major part of our manganese imports, continue to this day.

The manganese situation was serious enough back in 1949 when imports required were only 1,300,000 long tons. It became even more critical in 1952 when almost 2 million tons had to be imported and has steadily grown more serious.

In 1949 Dr. James Boyd, Director of the Bureau of Mines and Chairman of the Interdepartmental Manganese Coordinating Committee, stated to that Committee that since a year previous Government agencies had diligently followed a program to develop supplies of manganese. This Committee reviewed potential supplies from foreign sources, some of the information being included in the summaries below.

India

An engineer, who in 1949 had but recently returned from India, stated that conditions there did not indicate much encouragement in obtaining delivery of manganese ore, due, principally, to civil unrest and lack of rail transportation facilities to get ore to ports, aggravated by famine conditions requiring use of rail transport for transporting food. The main ore supplies are in the central provinces, which account for 75 percent of all production of manganese and for which there was available less than one-third of the necessary railway cars for handling ore. Subsequently, in 1953, with the assistance of substantial American technical and financial aid, India succeeded in shipping a little over 1 million tons. However, it should be pointed out, the same uncertainties (and even worse)—political and transportation—that hampered shipments late in 1948 and early 1949 continue to exist. Forty-two and eight-tenths percent of our 1954 manganese imports passed through the port of Goa, which is at present in a state of political unrest, being a bone of contention between India and Portugal. It must also be remembered that the ores in India are constantly getting lower in grade, requiring either upgrading or the shipping of larger tonnages of lower grade material.

Brazil

Supplies of any consequence from Urucum and Amapa deposits, Dr. Boyd reported in 1949, still were several years in the future. At the time of the writing of this report, some progress has been made on the legal technicalities at Urucum, but no physical development has started. Transportation connecting this deposit with the sea lanes will always be difficult, and those sea lanes are vulnerable.

The Amapa deposit, a large and the highest grade manganese deposit yet discovered in the Western Hemisphere, is being developed and shipping should start the middle of 1956. This operation has been almost wholly financed by the United States Government. Sea transportation will be a problem here also.

African Gold Coast

Supplies from this area are subject to a number of uncertainties, including manpower and equipment, as well as the usual transportation trouble, which will mitigate against expansion of that source. The grade of ore is dropping steadily.

Union of South Africa

Rail and port facilities were in bad shape in 1948 with but little improvement as of the present date (1955). Offers of technical assistance from the United States to improve the efficiency of the transportation were rejected during World War II and the Korean war, and there is an obvious lack of desire on the part of the Union of South Africa Government to cooperate in getting shipments through to the Western Hemisphere.

Political unrest in Africa at any time can add to the difficulties. It must be noted that in 1954 we imported 33.8 percent of our manganese from Africa, which, together with the Goa area accounts for 76.6 percent of our total imports, all from questionable or disturbed areas as well as entailing thousands of miles of sea transportation.

Russia

There was an awareness in 1949 that Russia was an uncertain source of supply that should be completely discounted in the future, and that any manganese ore which might come from Russia would be just that much velvet. This, of course, foreshadowed the complete cessation of shipments in 1950. During 1948 Russia supplied 25 percent of the manganese imports to the United States. In 1950 supplies from that source were cut off entirely without warning, and there has been no subsequent change.

It will be seen that while the principal sources of supply from foreign sources may be adequate in times of peace, they are the cause of grave concern and apprehension when an emergency arises, such as the Korean war, even though that war did not involve the safety of sea lanes. Political unrest and unfriendly attitudes on the part of foreign governments toward the United States, and poor or interrupted transportation facilities are sufficient in themselves in times of emergency to reduce shipments or to stop them entirely. The subcommittee has competent testimony to the effect that in another war one of the first expected acts of an enemy might well be the knocking out of our foreign sources of metals and minerals and the destruction of the ports from which they would be shipped. Such testimony given before the subcommittee by Major Alexander de Seversky was to the

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effect that we do not need to worry about transporting strategic minerals in the next war, that the sources will be knocked out, and there will be little or nothing to transport.

De Seversky states:

> I am convinced that all sources that are within striking distances of enemy airpower on the other side of the globe will be lost to us, and we won't be able to get 1 ounce of material from them.

And—

> today, in addition to the submarines, our Navy and its convoys can be attacked by long-range enemy aircraft and its atomic bombs anywhere on the seven seas. In the last war the enemy had no alternative but to attempt to cut our supply lines. Today he need not bother with our supply lines; he can strike directly at the sources of our strategic materials with his long-range airpower and neutralize them with atomic and hydrogen bombs.

Dr. Arthur S. Flemming, Director of the Office of Defense Mobilization, in testifying before the committee touched briefly upon the fallacy of any reliance upon foreign sources in case of war when he said:

> The President, a little over a year ago, directed us to set long-term stockpile objectives. In establishing those objectives he directed us to discount foreign sources of supply 100 percent, except for Canada, Mexico, and a few countries around the Caribbean.

Whether a foreign nation is friendly to the United States or not, advantage will be taken of our predicament and need in an emergency, and prices will be raised as they have been heretofore. The current world price for high-grade manganese ore is around 95 cents per unit. During the Korean war it was $1.25. The next time it may be $2 or more—in other words, whatever the traffic will bear, and that will be plenty.

The United States Government has displayed too little interest in the domestic minerals situation, not only in respect to manganese, but other minerals as well. The reason, perhaps, partly goes back to the fallacious theory that ours is a mineral "have-not" nation and we must buy our mineral supplies from abroad and partly that it is cheaper to do so. It is a theory which has been in vogue for a good many years and one that is dangerous to our national security. From the economic standpoint it would seem that the creation of new jobs in the United States would weigh more heavily in the scales than the saving of a few dollars by buying abroad.

DOMESTIC MANGANESE SOURCES

In addition to hundreds of smaller manganese deposits widely scattered throughout the United States, the following describes our major deposits.

Artillery Peak

Methods of mining and beneficiation were under study by the Bureau of Mines at this deposit as long as 7 years ago, preparatory, it was said then, to constructing a large-scale pilot plant, but nothing further than test-tube work has been reported.

Three Kids

The property is near to both Henderson and Boulder City, Nev. It is the largest single manganese deposit in the country on which full

scale, commercial beneficiation attempts have been made. The ore is a wad type, assaying 18 percent manganese. Reserves approximate 3 million tons.

During World War II, under a plancor contract, the property was drilled by the M. A. Hanna Co. under contract with the Government and 250,000 tons of material mined but not beneficiated. A plant for a sulfur dioxide process was erected, but was not successful. The project was abandoned at considerable loss to the Government.

Maine

The Bureau of Mines drilled the Aroostook County deposits. This work was finished about 4 years ago and disclosed approximately 200 million tons of siliceous ore, of 10 percent grade on the average which, it has been demonstrated, is amenable to treatment only by hydrochemical methods, such as the Nossen or similar processes.

Minnesota

The Cuyuna Range in Minnesota is regarded as having one of the largest reserves of low-grade manganese ores in the world, estimated to be in the hundreds of millions of tons. These ores assay 3 to 15 percent manganese and up to 37 percent iron.

The primary ores of the range are of 2 types: Green carbonate slate containing 3 to 8 percent manganese and 20 to 30 percent iron, which, on oxidation, yields the so-called brown ores containing about 9 percent manganese and 44 percent iron. The so-called black ores, derived from a cherty iron formation, yield about 15 percent manganese and 37 percent iron.

South Dakota

Millions upon millions of the so-called Chamberlain manganese ores are found in South Dakota. These ores are very low grade, averaging only about 3 percent. They have been found, however, to be amenable to treatment, and their relative value as a reserve stock will increase in future years as higher grade deposits both in this country and foreign lands are mined out.

RESEARCH PROJECTS

Manganese Chemicals Co.

This is a pilot plant cofinanced by Defense Materials Procurement Agency and the Manganese Chemicals Co. to test a process for the utilization of Cuyuna Range ores. The Government put up $2,250,000 and private capital $450,000. The process has been demonstrated to be entirely practical and the pilot plant is now operated as a commercial enterprise producing an exceedingly high-grade product which should bring a premium price.

The operation employs a chemical leaching method known as the Dean-Leute ammonium carbonate process. The pelletized concentrates of manganese carbonate run 65 percent in manganese with very low percentages of iron, alumina, silica, and phosphorus.

Commercial size equipment has been used throughout the plant which means that the usual difficulties encountered in putting into operation a full-scale plant already have been solved. The proven workability of this process indicates how our dependence on foreign sources of manganese can be decreased if the right efforts are made.

Additional work should be authorized to show the adaptability of the process for recovering manganese from other types of ore and from blast-furnace slag.

This plant has been operated under the direction of very competent engineers and sound management. There was a time when work almost came to a standstill, but the company was willing to put up a fair share of additional money to keep the job going, which finally resulted in success. Without this additional money, all previous funds invested would have been wasted.

Until this operation is on a competitive basis with free market prices, the Government should contract for its output at a figure which will keep the operation going. The subcommittee understands that negotiations for the sale of battery-grade manganese from this plant to the Signal Corps are underway. An ample source of battery-grade manganese in the United States is of great importance.

The Manganese Chemicals Co. project is the only one sufficiently advanced so that it gives promise that the Government will eventually stand a chance of recovering its investment, although, it should be said, the recovery of the investment should not be the principal object in research work, and should not be expected of strictly pilot and research plants.

Mangaslag, Inc.

A production contract was entered into by the General Services Administration with Mangaslag, Inc., which called for the erection of a pilot plant using a pyrometallurgical process to treat open-hearth slag from the steel mills for the recovery of manganese.

The Government ultimately put up $1,320,000 to match $780,000 put up by Mangaslag, Inc., for this project.

The pilot-plant operation was suspended in November 1954 when project funds were exhausted without a single pound of manganese having been produced.

The evidence clearly shows that this operation suffered from unsound management and from a lack of supervision by the proper governmental agencies. It also appears that the plant was operated too short a time to gather sufficient data as to the potential worth of the process, and it has been made plain that the private backers of this process are not interested in putting up further funds of their own to pursue the project.

Reactivation of the Mangaslag plant, which has reverted to the control and ownership of the General Services Administration, is under consideration and it is estimated that for an expenditure of approximately $1,500,000, definitive evaluation of the process can be obtained It would appear that this proposal is warranted as most of the metallurgical experts agree the process might have technical promise although the economic factors still leave much to be desired.

If all the currently produced slag available in the United States amenable to this process could be treated, approximately 1 million net tons of synthetic ore running 59.5 percent manganese could be recovered annually, or about half our annual consumption. There are in addition many hundred of millions of tons of slag in dumps which were produced at the open-hearth furnaces during the last 50 or more years. The best of these dumps, together with current production, would be an ample reserve for a large-scale manganese-recovery in-

dustry, and such an operation would put us well on the road toward self-sufficiency.

Byproducts of the process would be heavy melting iron scrap of high purity in the ratio of 2 tons for each ton of synthetic manganese ore recovered and substantial quantities of high-grade phosphate fertilizer. The sale of these 2 byproducts, it is estimated, should bring the cost of the recoverable manganese to about $1.40 per ton unit of 22.4 pounds.

One drawback of the Mangaslag process is that it requires substantial quantities of coke, which in times of emergency becomes a highly critical item. Coke is always in tight supply when the steel industry is running at high capacity as it is at present, and if the process under discussion does turn out to be feasible immediate steps would have to be taken to increase present coke production facilities before the process could be introduced on a large scale.

Nossen Laboratories

This company spent $400,000 of its own funds in development of the Nossen process prior to the time that the Government made a grant of $518,000 to the company for the construction and operation of the 12-ton-per-day pilot plant to test its nitric-acid process with particular application to the Aroostook County ores, although later under this Government contract considerable test work was done on other ores, including those stockpiled by GSA. Later this company spent an additional $160,000 of its own money.

In evaluating the work done at the Nossen Laboratories, John E. Conley, supervising chemical engineer for the Bureau of Mines, testified before the committee—

> that [Nossen Laboratories] were plagued with the usual difficulties which interfere with the operation of pilot plants. Delivery of equipment was behind schedule and neither the Nossen Laboratory nor GSA was responsible for that. The equipment manufacturers failed to deliver the equipment as promised * * *. Additional money should be provided to obtain the engineering data which is essential before you could translate the results to a commercial operation * * *. In other words, I would recommend that additional work be done to complete the tests and to acquire additional operating data, particularly data on the recovery of nitric acid.

The involved Government agencies are commended for their recently revealed plans to negotiate a $240,000 contract with Battelle Institute calling for working out the mechanical difficulties encountered in proving the chemical phases of this process.

GSA has stated in its report that the Nossen process is one of its most promising research and development projects. Test results show that ores from Deming stockpile were treated with a manganese recovery of 95 percent; nodules from Chamberlain, S. Dak., ores with an average recovery of 75 percent; ores from the Cuyuna Range with a manganese recovery of 86 percent; Aroostook ores with a manganese recovery of 80 percent.

Through application of the process our low-grade manganese ores can be converted with equal facility into chemical, metallurgical, and battery grade manganese. It should be pointed out that this latter battery grade manganese is high on the critical list.

Southwestern Engineering Co. projects

In addition to the above, the Southwestern Engineering Co. was engaged, at a cost of $250,000 to the Government, to sample and test

various types of low-grade, domestic ores, principally of the wad variety, such as are found in varying quantities and grade throughout most of the southern Appalachian region. This work was done to test the adaptability of these low-grade ores to conventional concentration and flotation methods. It was demonstrated that they were not adaptable and that hydrochemical methods would have to be used.

Three other processes now under consideration for which only relatively minor funds will be needed are:

Sylvester process

1. The Sylvester process consists essentially of mixing open hearth slag and limestone which is heated in a rotary kiln to produce oxides of the metallic elements which then can be smelted in blast or electric furnaces.

King process

2. Dr. Lowell W. King has proposed a process in which manganese dioxide is reduced to monoxide which can then be leached with hydrochloric acid.

Bruce-Williams process

3. The Bruce-Williams Laboratories has developed a process involving roasting and leaching, and on September 12, 1955, the General Services Administration entered into a contract with Ores Beneficiation, Inc., of Joplin, Mo., calling for erection of a pilot plant and running of tests of the Bruce-Williams Laboratories' process on slag and low-grade ores, including the Aroostook, Cuyuna, and those found in Arkansas, Arizona, New Mexico, and Mexico. Government underwriting of this project is limited to $202,100.

Pioche Manganese Co., Pioche, Nev.

This company formerly was engaged in mining manganiferous lead-zinc ores at Pioche, Nev. Manganese concentrates were obtained as a byproduct in milling these ores and ferromanganese was then made in an electric furnace at Henderson, Nev.

A drop in price of lead and zinc caused the Combined Metals mines to be shut down, thereby cutting off the supply of manganese. It proved impossible to operate using purchased manganese ores because of the cost, so while the process was successful technically, it was not successful financially and was shut down in April 1955 after three and a third million dollars had been spent on it—a large share of which was private money.

Westmoreland Manganese Co., Batesville, Ark.

Manganese has been mined in the Batesville area since 1848 when tonnage samples were sent to Sheffield, England, for experiments in steel-making. Shortly afterward shipments were sent to Pittsburgh and the use of manganese in steel making became regular practice.

The Batesville deposits occur over an area of 8 miles wide and 24 miles long. The ultimate source of the manganese is thought to have been from minute quantities disseminated throughout the limestone itself. The ore-bearing clays contain hard particles which can be recovered by washing and conventional gravity methods. This material will average 5 to 6 percent manganese. Streaks of large lump may contain 40 to 50 percent manganese. It is this material

which formed the basis of shipments in previous years. It was mostly mined by primitive underground methods.

In 1951, the property of the Westmoreland Manganese Co. was drilled under a Defense Minerals Administration contract and some 11 million tons of positive and inferred manganese bearing material was reported, averaging a little under 6 percent manganese. In 1952 a production contract was obtained from DMPA. The company planned to erect a mill having a capacity of 6,000 tons per day. The project was a failure and was not completed; and the Government was forced to move in and close it down and has since foreclosed and hopes to recover at least a part of its investment of $2,800,000.

Manganese, Inc.

In 1948 a cooperative agreement was made between Manganese, Inc., and the Bureau of Mines calling for use of the Bureau's test plant at Boulder City for research. In 1950 a contract was made by the company with the Government to mill the 280,000 tons of Three Kids ore which had been mined previously and to mine new ore. Commercial production has been achieved finally during the last 2 years after long research work and costly trials in the mill. The process is a flotation operation and the principal problem involved finding a suitable reagent. In this process concentrates are nodulized. Present production is at the rate of 9,000 tons of nodules per month running 48 percent manganese.

Here is an excellent example of what can be done under Government contract with low-grade ore, and it should be noted the Three Kids ore is about the same grade as those in the GSA purchase depots, although the type of ore is different.

Domestic Manganese & Development Co.

This company has been in the business of processing manganese ores for the Government since 1927, the year its rotary kiln nodulizing plant was built. The plant, located at Butte, Mont., operated on manganese carbonate ore belonging to the Anaconda Copper Mining Co. Between 1928 and 1941 almost 300,000 tons of oxide nodules were produced with an average manganese content of 58 percent.

In 1941 the company was requested by the War Production Board to erect a flotation mill, to be operated in conjunction with its nodulizing plant, to treat manganese ores which were to be purchased by Metals Reserve from the small producers in the Butte and Philipsburg districts. The plant was operated during World War II and produced 29,000 tons of nodules from 151,000 tons of crude oxide and carbonate ores. A total of 192,000 tons of crude ore was treated for the account of the Government during the years 1943 through 1945 and 3 months each in 1949 and 1950.

When the Korean war came in 1950, J. H. Cole, president of the company, was called to Washington by Dr. James Boyd, Administrator of Defense Minerals Administration, to help work out a price structure which would bring out manganese ore, under the Defense Production Act, from the small producers in the country. This conference resulted in a price of $2.30 per unit being set for Philipsburg carbonate ore and $2.25 for Butte carbonate ore. The $2.30 price was later adopted for the Wenden, Ariz., and Deming, N. Mex.,

purchase stations and the carlot program, less certain deductions and penalties.

During the winter of 1950–51 Mr. Cole spent several months in Washington conferring with officials of DMA and discussing plans for the reactivation of his company's flotation mill and nodulizing plant against the time when a sufficient backlog of ore should be accumulated at the Butte-Philipsburg depots to permit continuous operation of the mill.

As of July 31, 1955, a total of 56,950 tons of oxide and carbonate ore had been received at Butte and 62,649 tons at Philipsburg. Intake continues at the rate of about 2,500 tons per month.

This is the only station where both oxide and carbonate ores are purchased. The Butte plant site is also the site of the receiving station. The area adjacent to the plant is restricted in size and it will be necessary to acquire more storage ground elsewhere at considerable expense to the Government if the mill is not put in operation in the near future. The necessity for storing at a distance from the mill would require rehandling at considerable extra expense to the Government and this should be avoided if possible.

The plant has been kept in standby condition since 1950, but changes in the flow sheet will have to be made so as to handle efficiently the two classes of ore and the variations in the ores from different mines.

Pilot plant work is necessary to arrive at a proper flow sheet. There is a 1-ton experimental plant on the property which can be used, but the research work will have to have the blessing of the Bureau of Mines and the National Academy of Sciences and have the authorization of the Bureau of the Budget and Office of Defense Mobilization for the expenditure of the funds—in short the same heavy machinery of the Government has to be put in motion to obtain approval for a few-thousand-dollar job as for a multi-hundred-million-dollar job.

The General Services Administration advised on August 10, 1955, that the Bureau of Mines had been consulted on various phases of this proposed pilot plant work and that it has been cleared with them, and the necessary documentation has been prepared for the Bureau of the Budget with a request for an allocation of funds for this project.

It will probably cost $175,000 to get the mill in shape to operate on a new flow sheet. A year's operation on the stockpile presently available is assured and additional ore should be continuously received until June 30, 1955, at the present rate of intake.

REALISTIC PLANNING FOR THE FUTURE NEEDED

A decision is overdue as to what should be done, not only with the Butte-Philipsburg stockpile, but with those at Wenden and Deming as well.

As has happened so often in the past, during World War II there was a justified flurry of apprehension with respect to manganese which unfortunately quietly died down at the war's end, with practically nothing accomplished beyond the drilling of a few deposits. With the advent of the Korean war there was another flurry of excitement whipped up to hysteria to go out and get manganese at any cost. Today, with the pressure of being in a shooting war relieved, the

executive branch's interest in domestic manganese has waned almost to the vanishing point. The Congress alone shows interest in continuing efforts to keep the Nation's domestic minerals industry going and in broadening the mobilization base sufficiently to assure a measure of self-sufficiency in our mineral requirements in time of war.

In view of the executive branch's mercurial-like interest in the domestic minerals industry, which burns at a fever pitch at times and then subsides to a coma, it would appear the part of wisdom that the Congress create a United States Department of Mineral Resources, with the head thereof having Cabinet rank and transfer to it the functions of all bureaus and agencies having to do with minerals.

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